MATERIAL SAFETY DATA SHEET

1. SUBSTANCE AND SOURCE IDENTIFICATION

National Institute of Standards and Technology
Standard Reference Materials Program
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SRM Number: 3103a
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SRM Name: Arsenic Standard Solution

Date of Issue: 02 August 2006

Emergency Telephone ChemTrec:
1-800-424-9300 (North America)
+1-703-527-3887 (International)

Description: This Standard Reference Material (SRM) is intended for use as a primary calibration standard for the quantitative determination of arsenic. One unit of SRM 3103a consists of 50 mL of an acidified aqueous solution prepared gravimetrically to contain a known mass fraction of arsenic. The solution contains nitric acid at a volume fraction of approximately 10 %. The SRM is packaged in a high density polyethylene bottle sealed in an aluminized bag.

Material Name: Arsenic Standard Solution

Other Designations:

Arsenic: Arsenic-75; metallic arsenic; arsenic black; grey arsenic; colloidal arsenic.
Arsenic Acid: Orthoarsenic acid; Zotox; Desiccant L-10; CCA Type C; crab grass killer.
Nitric acid: Aqua fortis; hydronitrate; azotic acid; engraver's acid.

2. COMPOSITION AND INFORMATION ON HAZARDOUS INGREDIENTS

Component	CAS Registry	EC Number (EINECS)	Concentration (%)
Nitric Acid	7697-37-2	231-714-2	10
Arsenic Acid	7778-39-4	231-901-9	1.6
Arsenic	7440-38-2	231-148-6	1

EC Classification, R/S Phrases: Refer to Section 15, Regulatory Information.

3. HAZARDS IDENTIFICATION

NFPA Ratings (Scale 0-4): Health = 4 Fire = 0 Reactivity = 2

Major Health Hazards: Nitric acid and arsenic acid can cause severe or fatal burns if inhaled, swallowed, or absorbed through the skin. Arsenic can damage the nervous system, liver, skin, or respiratory tract. Chronic exposure to arsenic can cause cancer.

Physical Hazards: Container may rupture**.**

Potential Health Effects

Inhalation: Either nitric acid or arsenic acid, if inhaled, can damage the mucous membranes and upper respiratory tract, causing spasm, inflammation of the larynx and bronchi, chemical pneumonitis, and pulmonary edema. Symptoms may include burning sensation, coughing, wheezing, nosebleed, laryngitis, shortness of breath, headache, nausea, and vomiting. Long-term exposure to nitric acid can damage the teeth or jaw. Inhalation of arsenic can cause severe irritation of the upper respiratory tract. Symptoms may include couch, chest pain, difficult breathing, cyanosis, headache, nausea, vomiting, diarrhea, and low blood pressure. The body temperature may rise initially and then fall. Repeated or prolonged exposure to arsenic can cause weakness, loss of appetite, perforation of the nasal septum, and lung cancer.

Skin Contact: Nitric acid and arsenic acid can cause severe skin irritation and burns, often delayed. Skin contact with arsenic can cause redness, swelling, and various types of skin lesions (eczema, dermatitis, papules, pustules, warts, hyperkeratosis), loss of hair, changes in skin pigmentation, and skin cancers. These tumors, unlike those caused by ultraviolet radiation, often appear on the palms, soles, or other parts of the body not exposed to sunlight.

Eye Contact: Nitric acid and arsenic acid can cause severe eye irritation, corneal burns, permanent eye damage, or blindness. Eye contact with arsenic dust can cause irritation and sensitivity to light. Pigment spots may also appear in the cornea and conjunctiva.

Ingestion: Nitric acid and arsenic acid can cause severe burns and damage to the GI tract. Ingestion of arsenic can damage the nervous system, causing symptoms such as muscular weakness, paralysis, optic neuritis (inflammation of the optic nerve), or burning pains in the hands and feet. A large dose (70 to 180 mg) may cause fever, enlargement of the liver, an irregular heartbeat, and death. Chronic exposure to arsenic sometimes causes white bands across the fingernails. It can also cause liver disease, peripheral vascular disease, and various blood abnormalities, including aplastic anemia. Arsenic may cross the placental barrier.

Medical Conditions Aggravated by Exposure: Immune system deficiencies; skin rashes; liver disease.

Listed as a Carcinogen/ Potential Carcinogen:

	Yes	No
In the National Toxicology Program (NTP) Report on Carcinogens	X	
In the International Agency for Research on Cancer (IARC) Monographs	X	
By the Occupational Safety and Health Administration (OSHA)	X	

Note: Chronic exposure to arsenic is associated with skin and lung cancer in humans. The estimated latency time is 15 to 30 years.

4. FIRST AID MEASURES

Inhalation: Move the person to fresh air immediately. If not breathing, qualified personnel may start CPR or give oxygen if necessary. Get medical aid at once, and bring the container or label.

Skin Contact: Remove contaminated clothing and shoes. Wash affected skin thoroughly with soap and water. The full extent of acid burns may not be apparent for 12 to 14 hours after exposure. If burns are severe or if skin irritation persists, get medical aid and bring the container or label. Wash contaminated clothing before reusing.

Eye Contact: Remove contact lenses (if any). Do not allow victim to rub eyes or keep eyes closed. Flush eyes with large amounts of running water for at least 15 minutes, keeping eyelids open and raising lids to remove all chemical. Get medical aid at once, and bring the container or label.

Ingestion: Contact a poison control center immediately for instructions. Wash out mouth with water, but **do not** induce vomiting. Get medical aid at once, and bring the container or label.

Note to Physician (Nitric Acid): Wash affected skin with 5% solution of sodium bicarbonate ($NaHCO_2$). If ingested, the risk vs. benefit of a nasogastric tube is debatable. Activated charcoal is of no value. Do not give bicarbonate to neutralize the material.

5. FIRE FIGHTING MEASURES

Fire and Explosion Hazards: Although nitric acid does not burn, it is a powerful oxidizing agent that can react with combustible materials to cause fires. Arsenic and arsenic acid are negligible fire hazards when exposed to heat or flames.

Extinguishing Media: Use extinguishing media appropriate to the surrounding fire: water spray, dry chemical, carbon dioxide, or foam. Use a water spray to dilute nitric acid and hydrofluoric acid and to absorb liberated oxides of nitrogen. (These guidelines apply to the mixture; when the components are considered separately, different precautions may apply.)

Fire Fighting: Avoid inhalation of material or combustion byproducts. Wear full protective clothing and NIOSH-approved self-contained breathing apparatus (SCBA).

Flash Point (°C): N/A

Autoignition (°C): N/A

Flammability Limits in Air: N/A

Lower Explosive Limit (LEL): N/A

Upper Explosive Limit (UEL): N/A

Flammability Class (OSHA): N/A

Products of Combustion: Thermal decomposition of nitric acid can produce nitric acid mist or vapor and various nitrogen oxides, including nitric oxide (NO), nitrogen dioxide (NO_2), and nitrous oxide (N_2O). Thermal decomposition of arsenic and arsenic acid may release toxic and/or hazardous gases.

6. ACCIDENTAL RELEASE MEASURES

Occupational Release: Notify safety personnel of spills. Surfaces contaminated with this material should be covered with soda ash or sodium bicarbonate to neutralize the acid. Place the neutralized material into containers suitable for eventual disposal, reclamation, or destruction.

Disposal: Refer to Section 13, Disposal Considerations.

7. HANDLING AND STORAGE

Storage: Store unopened containers of this material in a dry place at room temperature. Protect from physical damage, heat, and light. Isolate from incompatible materials. Use opened containers immediately or discard.

Safe Handling Precautions: Wear gloves and chemical safety goggles (Section 8). Engineering controls should maintain airborne concentrations below TLV (Section 8). Wash exposed skin with soap and warm water several times a day and before eating. Do not eat or keep food in the work area. Remove contaminated clothing before leaving work.

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

Nitric Acid:

ACGIH TLV-TWA: 2 ppm or 5 mg/m^3

OSHA TLV-TWA: 2 ppm or 5 mg/m^3

Arsenic Acid:

ACGIH TLV-TWA: 0.01 mg/kg

OSHA TLV-TWA: 10 µg/kg

Arsenic:

ACGIH TLV-TWA: 0.01 mg/m^3

OSHA TLV-TWA: 10 µg /m^3

Ventilation: Use local or general exhaust to keep employee exposures below limits. Local exhaust ventilation is preferred because it can control contaminant emissions at the source, preventing dispersion into the general work area. Refer to the ACGIH document *Industrial Ventilation, a Manual of Recommended Practices*.

Respirator: If necessary, refer to the NIOSH document *Guide to the Selection and Use of Particulate Respirators Certified under 42 CFR 84* for selection and use of respirators certified by NIOSH.

Eye Protection: Use chemical safety goggles where dusting or splashing of solutions may occur. See OSHA standard (29 CFR 1910.133) or European Standard EN166. The employer should provide an emergency eye wash fountain and safety shower in the immediate work area.

Personal Protection: Wear appropriate gloves and protective clothing to prevent contact with skin.

9. PHYSICAL AND CHEMICAL PROPERTIES

Nitric Acid	Arsenic Acid	Arsenic
Appearance and Odor: Colorless to slightly yellow liquid, darkens to brown upon aging and exposure to light; irritating, pungent odor.	**Appearance and Odor:** Colorless or white crystals.	**Appearance and Odor:** A gray or black solid with the odor of garlic.
Relative Molecular Weight: 63.02	**Relative Molecular Weight:** 141.93	**Relative Atomic Weight:** 74.92
Molecular Formula: HNO_3	**Molecular Formula:** AsH_3O_4	**Molecular Formula:** As
Density (g/cm^3): 1.05 (10%)	**Density (g/cm^3):** 2.0	**Density (g/cm^3):** 5.7
Solvent Solubility: Decomposes in alcohol	**Solvent Solubility:** Soluble in alcohol, glycerol, and alkali materials.	**Solvent Solubility:** Soluble in nitric acid.
Water Solubility: Soluble	**Water Solubility:** Soluble	**Water Solubility:** Insoluble
Vapor Density (Air=1): 2.17	**Vapor Density (Air=1):** N/A	**Vapor Density (Air=1):** N/A
pH: 1.0 (0.1 M solution)	**pH:** 1.0	**pH:** N/A

NOTE: The physical and chemical data provided are for the pure components. No physical or chemical data are available for this solution of arsenic, arsenic acid, and nitric acid. The actual behavior of the solution may differ from the individual components. The appearance of the solution is clear.

10. STABILITY AND REACTIVITY

Stability: __X__ Stable _____Unstable

Stable at normal temperatures and pressure.

Conditions to Avoid: Contact with combustible or incompatible materials; heat.

Incompatible Materials:

Nitric Acid: Incompatible with numerous materials including organic materials, plastics, rubber, chlorine, and metal ferrocyanide.

Arsenic: Incompatible with acids, acid fumes, oxidizing agents, halogens, palladium, zinc, platinum, nitrogen trichloride, silver nitrate, acetylenes, chlorosylamine, chromium (VI) oxide, sodium peroxide, dirubidium acetylide. (Arsenic acid may precipitate upon evaporation or drying of the solution.)

Arsenic acid: Incompatible with hot hydrochloric acid (evolves chlorine), iodides, metals.

Fire/Explosion Information: See Section 5.

Hazardous Decomposition: Thermal decomposition of nitric acid can produce nitric acid mist and nitrogen oxides, including nitric oxide (NO), nitrogen dioxide (NO_2), and nitrous oxide (N_2O). Thermal decomposition of arsenic and arsenic acid may release AsO_3 and other oxides. Under reducing conditions (strong acid or base plus a metal), or in the presence of hydrogen, highly toxic arsine gas may be produced.

Hazardous Polymerization: _____ Will Occur __X__ Will Not Occur

11. TOXICOLOGICAL INFORMATION

Route of Entry: __X__ Inhalation __X__ Skin __X__ Ingestion

Nitric Acid:

Human, oral (LD_{Lo}): 430 mg/kg
Rat, oral (LD_{50}): > 90 mg/kg
Rat, inhalation (LC_{50}/4 hrs): 130 mg/m^3

Arsenic Acid:

Rat, oral (LD_{50}): 48 mg/kg

Arsenic:

Rat, oral (LD_{50}): 763 mg/kg
Human, oral (TD_{Lo}): 7857 mg/kg/55 yrs

Target Organ(s):

Nitric Acid: skin, teeth, eyes, upper respiratory tract.
Arsenic and Arsenic Acid: immune system (sensitizer), nervous system, liver, kidneys, heart, GI tract.

Mutagen/Teratogen: Arsenic compounds can interfere with the process of DNA synthesis. High doses of inorganic arsenic compounds given to pregnant laboratory animals have caused various malformations. In humans, however, occupational exposure to arsenic apparently is not associated with an excess of birth defects.

Health Effects: See Section 3.

12. ECOLOGICAL INFORMATION

Nitric Acid:

Green shore crab (*Carcinus maenas*), LC_{50} (48 hrs): 180,000 µg/L

Starfish (*Asterias rubens*), LC_{50} (48 hrs): 100,000 to 330,000 µg/L

Hooknose (*Agonus cataphractus*), LC_{50} (48 hrs): 100,000 to 330,000 µg/L

Arsenic Acid:

Bluegill (*Lepomis macrochirus*), LC_{50} (96 hrs): 50,000 µg/L

Sheepshead minnow (*Cyprinodon variegatus*), LC_{50} (96 hrs): 28,000 µg/L

Arsenic:

In freshwater and marine environments, most arsenic is found in sediment rather than in water. Arsenic also bioaccumulates in some aquatic organisms. Ecotoxicity data:

Fathead minnow (*Pimephales promelas*), LC_{50} (96 hrs): 9,900 µg/L

Brown mussel (*Perna perna*), EC_{50} (1 hr): 4,000 µg/L

Water flea (*Ceriodaphnia reticulata*), LC_{50} (48 hrs): 1,900 µg/L

Environmental Summary: This mixture is expected to be slightly toxic to aquatic life.

13. DISPOSAL CONSIDERATIONS

Waste Disposal: One or more components of this mixture is a RCRA hazardous waste. Dispose of container and unused contents in accordance with federal, state, and local requirements, which vary according to location. Decontaminate containers before recycling. Processing, use, or contamination of this product may change the waste management options.

14. TRANSPORTATION INFORMATION

U.S. DOT and IATA: Nitric Acid Solution: Hazard Class 8, UN2031, Packing Group II

15. REGULATORY INFORMATION

U.S. REGULATIONS

CERCLA Sections 102a/103 (40 CFR 302.4):

Arsenic: RQ = 1 lb.
Arsenic Acid: RQ = 1 lb.
Nitric Acid: RQ = 1000 lb.

SARA Title III Section 302: Nitric acid is regulated

SARA Title III Section 304: Nitric acid is regulated

SARA Title III Section 313: All three components are regulated

OSHA Process Safety (29 CFR 1910.119): Nitric acid at higher concentrations ($\geq$ 94.5%) is regulated.

SARA Title III Sections 311/312 Hazardous Categories (40 CFR 370.21):

ACUTE:	Yes
CHRONIC:	Yes
FIRE:	No
REACTIVE:	Yes
SUDDEN RELEASE:	No

STATE REGULATIONS

California Proposition 65: Inorganic arsenic compounds are regulated.
New Jersey and Pennsylvania Right to Know Lists: Nitric acid and arsenic are regulated.

CANADIAN REGULATIONS

WHMIS Classification:

Nitric Acid: C (oxidizing material), D1A (very toxic material), E (corrosive material)
Arsenic Acid: D1A (very toxic material), E (corrosive material)
Arsenic: D1A (very toxic material)

WHMIS Ingredient Disclosure List: All three components are regulated.

CEPA Domestic Substances List (DSL): All three components are regulated.

EUROPEAN REGULATIONS

EU/EC Classification:

Nitric Acid: O (Oxidizing), C (Corrosive)

Arsenic Acid: XN (Harmful); not classified in Annex I of Directive 67/548/EEC; not on a priority list.

Arsenic: T (Toxic), N (Dangerous for the Environment)

Risk Phrases (mixture):

R23 (toxic by inhalation)

R25 (toxic if swallowed)

R34 (causes burns)

R36/37/38 (irritating to eyes, respiratory system and skin)

R50/53 (toxic to aquatic organisms, may cause long-term environmental damage)

Safety Phrases (mixture):

S20/21 (when using, do not eat, drink or smoke)

S28 (wash after contact with skin)

S45 (in case of accident or illness, see doctor; show label)

S60 (dispose of this material and its container as hazardous waste)

S61 (avoid release to the environment)

NATIONAL INVENTORY STATUS

U.S. Inventory (TSCA): All components are listed

TSCA 12(b), Export Notification: No components are listed

16. OTHER INFORMATION

Sources:

Amdur M.O., et al., *Casarett and Doull's Toxicology: The Basic Science of Poisons.* 4th Ed. New York: McGraw-Hill, 1993.

PAN Pesticide Database: Arsenic and Arsenic Acid.

IUCLID Dataset: Arsenic Acid. European Commission, European Chemicals Bureau, 19 February 2000.

IUCLID Dataset: Nitric Acid. European Commission, European Chemicals Bureau, 19 February 2000.

PAN Pesticide Database: Nitric Acid.

U.S. National Institute for Occupational Safety and Health, *NIOSH Pocket Guide to Chemical Hazards*, June 1990 edition. DHHS (NIOSH) Publication No. 90-117.

Disclaimer: Physical and chemical data contained in this MSDS are provided only for use as a guide in assessing the hazardous nature of the material. The MSDS was prepared carefully, using current references; however, NIST does not certify the data in the MSDS. The certified values for this material are given in the NIST Certificate of Analysis.